**Table S1. Study-level methodological quality appraisal**

| Study | Study title | Methods and evidence | Potential bias or uncertainty | Support for conclusions | Validation or evaluation | DOI | Check - Decision |
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| García Rojas (2026) | Additive Manufacturing of High Heels Using the Input–Transformation–Output Model: Comparative Evaluation of PLA, ABS and ABS Photopolymer Resin Materials | The study design and main methods are described sufficiently to follow how the comparison was conducted: three materials were evaluated across five selected heel geometries, with five specimens per material-test combination, standardized mechanical testing, SEM, static simulation, and screw assembly testing. | Reproducibility and attribution are limited by acknowledged uncontrolled environmental conditions, unvaried printing orientation, and five specimens per test–material combination. | The conclusions are partly well-supported and appropriately qualified: the reported compression testing and assembly observations support condition-specific recommendations for ABS-like resin, while the mechanical comparisons support trade-offs rather than a universal best material. | Mechanical and functional evaluation: The study combined mechanical testing, SEM, numerical simulation, and real fastening tests, using five specimens per material-test combination. | 10.3390/jmmp10040119 | Verified against full text - Included |
| Zhang (2024) | Pressure-Reducing Design of 3D-Printed Diabetic Shoe Midsole Utilizing Auxetic Lattice Structure | The study combines finite-element simulation with in-shoe pressure testing; it reports model inputs and procedures, including a single scanned male foot model, motion-capture-based loading, a Yeoh TPU material model, and a 2 mm mesh, alongside an experimental protocol using 20 healthy adults and a 99-sensor Pedar-X system. | Population and generalizability: Pressure testing used 20 healthy adults, not people with diabetes, limiting how confidently results can be applied to the intended patient group. | The conclusions are partially supported: reported finite-element results show lower regional peak pressures and greater plantar contact areas for auxetic midsoles, particularly A60, than for N90 under the modeled walking and running conditions reported regional reductions running reductions FEA contact areas. | Validation: mean results from 20 participants were compared with FE simulations, with the authors reporting high similarity in regional peak pressure and contact area. | 10.3390/app14125291 | Verified against full text - Included |
| Cracknell (2025) | Static and dynamic optimisation of fluid-filled responsive orthotic insoles | The study design and workflow are described in enough detail to follow: one subject's static and walking pressure measurements informed staged numerical gait models, and a regional gradient-based optimisation adjusted insole geometry; an F-Scan walking test compared the manufactured insole with numerical predictions. | The main risk of bias is limited generalizability: the study used the primary author as its participant, so results from this individual cannot establish performance across the wider footwear-user population. | The reported results support the limited conclusion that the customised insole optimisation reduced pressure measures in the study models: static peak pressures by approximately 8% and summed dynamic peak pressures by 50%; Table 3 also reports lower median pressure with the optimised versus initial insole at each gait stage. | Model validation: numerical gait results were reported to correlate well with experimental results, with differences attributed in part to non-subject-specific bone geometry; agreement was described as particularly good in later gait stages. | 10.1007/s10237-025-01935-w | Verified against full text - Included |
| Xie (2021) | Study on Design and Additive Manufacturing of Customized Bionic Sports Sole for the Elderly | The study design and main procedures are described sufficiently to follow how the authors produced the findings: foot scanning/modeling, standardized tensile testing, Ogden-model finite element simulation and optimization, and comparative friction testing analyzed with AHP are specified. | Tensile-test variability and reproducibility are difficult to assess: the paper reports averaging three tests but supplies no dispersion estimate in the cited description. | The conclusions are reasonably supported for the demonstrated technical outcomes: the simulation reports lower peak impact stress after shape optimization, and the AHP ranking places the leopard-paw pattern highest among the compared patterns. | Tensile properties: Each specimen was tested three times, with similar test-condition results, and the average was used; increasing printing temperature increased tensile limit and decreased maximum strain, with curves close at 210°C and 220°C | 10.1109/ACCESS.2021.3078162 | Verified against full text - Included |
| Sadeghi (2018) | Balancing mixed-model assembly systems in the footwear industry with a variable neighbourhood descent method | The paper describes an applied computational study of randomly generated small instances and real data from two footwear-company stitching lines, with the input preparation, RPW-VNDbal construction and VND improvement steps, software, hardware, and simulation procedure specified. study_scope input_preparation algorithm_description software_and_hardware simulation_method | Evidence is from a single footwear company and two of its stitching lines, limiting generalizability to other footwear settings. | The conclusions are reasonably supported for the studied case: the method matches or nearly matches optima on the five small instances, performs better than the company solutions on all 14 real instances reported, and has reported real-instance lower-bound gaps of 0%–14%. | Small instances: The method matched the optimum in 3 of 5 instances; the other 2 had gaps below 1%. | 10.1016/j.cie.2018.05.020 | Verified against full text - Included |
| Wang (2022) | A Hybrid OPA and Fuzzy MARCOS Methodology for Sustainable Supplier Selection with Technology 4.0 Evaluation | The methods and inputs are described sufficiently to follow how the rankings were produced: OPA weights 12 literature- and expert-informed criteria, then fuzzy MARCOS uses fuzzy assessments of five hypothetical suppliers to rank them. | The authors acknowledge limitations in the number of alternatives, factors, and geographic scope; the case uses five hypothetically assigned Vietnamese manufacturers, so generalizability beyond this setting is limited. | The conclusions are supported for the paper's modeled case: the reported OPA weights identify the same leading criteria, and fuzzy MARCOS ranks SUP-03 first. criteria_weights supplier_results | The study evaluated a hypothetical case of five Vietnamese leather and footwear suppliers; literature-informed criteria were validated using relevant experts' opinions. | 10.3390/pr10112351 | Verified against full text - Included |
| Huang (2025) | Real-Time 3D Vision-Based Robotic Path Planning for Automated Adhesive Spraying on Lasted Uppers in Footwear Manufacturing | The study design and technical workflow are described sufficiently to understand how the system generated and executed adhesive paths and how coverage was inspected, using an industrial implementation test on one specified shoe model Study tested a sports casual shoe in realistic production conditions. | External validity is limited: the implementation test used one sports-casual shoe product and the reported deployment is one production line in Hanoi, so performance across other styles, materials, and sites is uncertain. | The reported repeatability (−0.4 to +0.5 mm), generally in-tolerance adhesive coverage, and live-line installation support the conclusion that the system can perform automated adhesive spraying with useful accuracy in the tested production setting. | Adhesive coverage: UV inspection against manually drawn reference lines found most areas within the industry-accepted 1 mm tolerance, with slight toe-cap deviation most areas within tolerance. | 10.3390/app15116365 | Verified against full text - Included |
| Lau (2025) | Estimating the slip resistant quality of winter footwear using Artificial Intelligence | The methods are described clearly enough to understand how the results were produced: 266 footwear samples were labelled using the human-centered MAA protocol, images were preprocessed, and transfer-learning CNNs were tuned with five-fold cross-validation and assessed on held-out footwear using standard classification metrics. | The authors acknowledge the small dataset (266 footwear samples) and restrict applicability to rubber, Arctic Grip, and Green Diamond outsoles; augmentation and transfer learning are used to mitigate sample-size constraints, but do not establish generalizability to other materials. | The reported results support a qualified conclusion that the model can classify slip resistance in the tested footwear: the best test F1-score was 0.89 and the best AUC was 0.91, both for the wet-ice, outsole-image, Xception configuration best test F1-score AUC result. | Held-out model evaluation: the best configuration used wet-ice MAA labels, outsole images, and Xception; test accuracy was 0.85, precision 0.84, recall 0.94, and F1-score 0.89. | 10.1016/j.ssci.2024.106686 | Verified against full text - Included |
| González (2024) | Development of a collaborative robotic system to polish leather surfaces | The study design and system workflow are described sufficiently to understand the practical method: requirements interviews, mock-up validation, manual-to-CAD trajectory options, and factory testing. | The findings have practical support from a 20-week factory deployment, but the evidence is limited by a six-person usability sample drawn from one factory, with only two patina operators, and participant-reported test averages; generalizability and comparative robustness are therefore uncertain. | The conclusions are partly supported by practical but limited evidence: the factory deployment and reported productivity increase support feasibility and productivity claims in this setting, while workflow-related productivity losses are also acknowledged 20 weeks and 25% productivity increase. | Factory deployment: Used for 20 weeks; the authors report a 25% productivity increase, though manual shoe removal and HMI-menu access can reduce productivity | 10.1080/0951192X.2023.2209874 | Verified against full text - Included |
| Chiu (2022) | A novel directional object detection method for piled objects using a hybrid region-based convolutional neural network | Study design and analysis: A three-stage study prepared and labelled images, trained Faster R-CNN and Mask R-CNN, and integrated their outputs to estimate object position and rotation; the paper explains how the mask-derived rotated rectangle and direction reference point are combined. | Findings are limited by use of a simulated, augmented dataset because the relevant real factory images were unavailable; transfer to actual production conditions is uncertain, and the authors say further practical applications need more data. | The integrated method's reported 96.26% success rate supports its performance on the authors' limited evaluation, but confidence in generalization is restricted because it used simulated training data and only 30 final-test images; the authors also acknowledge the need for more data and mask inaccuracies. | Integrated performance: Experts assessed results against manual arranging standards; on 30 test images, 103 of 107 selected insoles were judged successful (96.26% detection accuracy) | 10.1016/j.aei.2021.101448 | Verified against full text - Included |
| Lucas (2024) | Simulation model to analyze the impact of work on absenteeism | Ergonomic Work Analysis and company data informed a Vensim System Dynamics model of a 15-worker footwear production cell. Equations, scenario definitions and checks are reported; underlying individual-level health data are not shared. | Single-company cell and company-led model review limit independent validation; incomplete health-record detail and omitted variables may affect predictions. Extrapolation to 13 similar cells assumes the model transfers. | Reported baseline fit and scenario estimates support the model as an exploratory decision aid, but predicted changes in absenteeism do not establish observed causal effects of altered schedules. | Model assessed against baseline company production/health indicators, structural checks, company review and overtime/recovery sensitivity scenarios; no prospective intervention or external-company validation. | 10.1002/hfm.21052 | Verified against full text - Included |
| Tsang (2025) | Demonstration of curing degree estimation approach of EVA foam during injection moulding by integrating thermal–physical characteristics and FEA simulation | The study uses cuboid EVA samples for thermal characterization and footwear-shaped samples for application, measuring reaction characteristics with DSC/TMA and thermal properties with TPS before applying transient thermal FEA. | The estimates rely on idealized or estimated mould-interface heat transfer properties, and the supplied report does not describe an uncertainty or sensitivity analysis for those assumptions as stated. | The conclusions are reasonably supported for demonstrating an experiment-informed FEA approach and predicting contrasting curing patterns under ideal and actual heat transfer conditions; measured thermal inputs and the reported simulations underpin those claims. | The approach was evaluated using experimental mould-temperature observations and FEA comparison of ideal versus actual heat transfer; the paper reports that actual heat transfer delayed curing relative to the ideal condition, with only a small region uncured at 600 s, and reports production of a footwear-shaped sample without oxidation or burning The approach was demonstrated with experiment and FEA, and the footwear-shaped sample was produced without oxidation or burning | 10.1007/s00289-024-05568-4 | Verified against full text - Included |
| Huang (2026) | Adaptive junction line detection for robotic footwear assembly using contour sensing and shoe-last-based geometric matching | The study design and analytical approach are described sufficiently to follow how findings were generated: it evaluates 36 assemblies spanning three footwear categories, three designs, two sizes, and left/right shoes; measures accuracy against a manually drawn reference path using a 3D measuring arm; and defines error as the maximum distance to that reference. | The study identifies several relevant uncertainties: reference-path measurement, coordinate transformation, robot repeatability, and sensor calibration contribute to reported system-level error; the comparison with prior studies is not statistically tested because the studies differ in platforms, samples, sensing configurations, and protocols and often lack repeated raw data. | The conclusions are reasonably supported for the tested shoes and baseline sensing setup, rather than established broadly for footwear production. | Validation scope and accuracy: Complete junction lines were detected in all 36 cases under the nominal 300-mm, local-normal-aligned condition, with maximum error below 0.3 mm; manual drawn trajectories measured with a 0.025-mm-precision 3D measuring arm served as the reference. | 10.1007/s00170-026-18316-x | Verified against full text - Included |
| Papetti (2020) | A method to improve workers' well-being toward human-centered connected factories | The study clearly describes a six-step, iterative method, its ergonomic assessment options, IoT measures and sensors, and the data-cleaning, peak-analysis, video-matching, and correlation procedures used to produce the findings.method_steps assessment_methods iot_kpis device_setup analysis_procedure | The principal acknowledged limitation is the small sample: only two operators were sensorized, and the authors state that testing should be extended to more operators and companies to achieve statistical significance the authors identify sample size as a main limitation and call for broader experimentation. | The conclusions are supported as a case-specific demonstration: measurements identified ergonomic and environmental issues and informed proposed corrective actions. | The real-plant evaluation identified greater physical workload and more awkward-posture warnings for OP1, while OP2 had higher average HR (117 vs 89 bpm) and BR (18 vs 14 bpm); the authors judged both operators' effort acceptable overall but OP2 more physically stressed Posture and physiological findings | 10.1093/jcde/qwaa047 | Verified against full text - Included |

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| Sheward (2026) | Artificial Muscles for Footwear Technology: Knitting Structures With Variable Elasticity | The bench-test design is described sufficiently to understand the basic procedures: Instron compression and 120-second relaxation tests compare silicone substrates, knitting patterns, and voltage states, with MANOVA and an independent t-test used for analysis test_setup compression_protocol relaxation_protocol statistical_methods. | The findings are preliminary evidence from controlled material tests, not validation of footwear performance in use. | The conclusions are partly supported: the reported bench tests support actuation-related changes in compressive stress for the tested silicone/pattern combinations, including the high response reported for Pattern C, but statistical reporting is inconsistent and the independence of the very large stated sample sizes is unclear. | Bench testing: Controlled compression cycling and 120-second creep/relaxation testing were used across substrate, pattern, and voltage conditions. | 10.1155/amse/9046033 | Verified against full text - Included |
| Seul (2023) | The Influence of Materials on Footwear Behaviour: A Finite Element Simulation Study | The study is a comparative finite-element simulation of three casual shoe models with identical design lines and different calfskin/knit upper configurations; foot geometry was informed by measurements from 32 women. | The authors acknowledge important limitations: posture and muscle activity are not included in the boundary conditions; mesh refinement and validation against experimental data could be improved; input uncertainty in material properties and geometry was not quantified; and layers and overlap zones in the upper were not examined. | The conclusions are reasonably supported for the three simulated footwear configurations and the reported deformation and stress measures: the numerical results show higher stress for M2 and lower deformation for M3 than M2, consistent with the stated material-combination interpretation. stress_results stress_model_comparison T1 deformation comparison conclusion_claim | Evaluated results: deformation, equivalent von Mises stress, and equivalent elastic strain were compared across three upper-material models and gait phases. | 10.3390/ma16227203 | Verified against full text - Included |
| Tafuro (2025) | Self-supervised Vision-driven Trajectory Planning for Intelligent Robotic Deburring | The study design and analysis are described sufficiently to follow: a three-stage vision, action-learning, and Sim-to-Real pipeline is evaluated using simulated and real images, supervised/self-supervised learning variants, and stated trajectory-error metrics the pipeline simulation data acting training evaluation metrics. | The study acknowledges important limitations: it does not model material-cutting dynamics and focuses on generating high-level trajectories rather than validating the cutting process itself cutting dynamics were not modeled the focus is on linking visual data to high-level trajectories. | The conclusions are supported for the limited claim that the proposed self-supervised contextual-bandit method generates more accurate predicted trajectories than the tested alternatives in the reported experiments, including on held-out sole types; the tables report its lowest trajectory-prediction error among the compared agents in simulation and reality, and lower test-soles error than the cited benchmark method. | Quantitative evaluation: trajectory-prediction error for the CB SSL agent was 25.38 mm in the simulation learn-to-act results; in the simulation/reality comparison it was 25.47 mm in simulation and 25.79 mm in reality. | 10.1007/s11633-025-1560-6 | Verified against full text - Included |
| Fay (2024) | Modeling Running via Optimal Control for Shoe Design | The study design, model, data source and sample, running protocol, and optimization method are described sufficiently to follow how the predictions were produced. | Model specification: The identified cost components depend on the chosen basis functions, and the threshold for omitting components may affect predicted gait basis-function limitation threshold limitation. | The conclusions are partly supported: results show predicted performance differences across substantially varied shoe stiffness profiles, supporting the stated use for coarse-grain exploration of novel designs. | Gait-fit evaluation: Real running data from 28 subjects informed inverse optimal control; the best-matching objective included ground impulse and leg-muscle mechanical work, with hip-muscle activity also contributing at higher speeds. | 10.1115/1.4064405 | Verified against full text - Included |
| Román-Ibáñez (2018) | Distributed monitoring of heterogeneous robotic cells. A proposal for the footwear industry 4.0 | Study design and data: A software-based monitoring system was designed, built, and tested in a laboratory prototype representing one factory with four robotic cells; described cells included Universal Robots, ABB, and Comau arms, and status data were polled by a local server. | The findings are primarily a laboratory feasibility demonstration, not validation in operating footwear factories; the authors state that no sufficiently automated footwear company was available for integration testing testing was limited to a laboratory environment. | The conclusions are supported for feasibility and lower bandwidth/storage under the reported laboratory test conditions: the study describes a prototype and acknowledges that testing was limited to a laboratory, while the comparison table reports the camera and proposed-method bandwidth/storage values. | Table T1 reports bandwidth and daily storage at 30 FPS: 480p MPEG, 7.2 Mbps and 54.3 GB/day; 480p H.264, 1.4 Mbps and 108.9 GB/day; 720p MPEG, 19.2 Mbps and 1,500 GB/day; 720p H.264, 3.8 Mbps and 290.3 GB/day; proposed RAW, 5.625 Kbps and 65.6 MB/day; proposed ZIP, 3.626 Kbps and 42.3 MB/day table_comparison | 10.1080/0951192X.2018.1529432 | Verified against full text - Included |
| Jadhav (2019) | Ergonomics design and evaluation of the stitching workstation for the hand-crafted Kolhapuri footwear using a digital human modeling approach | The study describes a software monitoring system and a four-cell laboratory prototype, including use of different robot manufacturers; the setup and broad procedure are understandable, but the evidence is limited to a laboratory because sufficiently automated footwear companies were unavailable for testing. | External validity: Testing was limited to a laboratory; the prototype was one simulated factory with four cells selected because they were available, and the authors identify testing outside the test bench as future work experiments were limited to a laboratory environment four-cell prototype cells available in laboratory future validation | The conclusions about prototype feasibility and lower bandwidth/storage are supported within the reported laboratory tests, including the comparative resource values in the table. | Laboratory prototype evaluation only; the authors state that tests were limited to a laboratory because sufficiently automated footwear companies were unavailable testing_scope. | 10.1080/21681015.2019.1702593 | Verified against full text - Included |
| Tsai (2020) | Utilization of a reinforcement learning algorithm for the accurate alignment of a robotic arm in a complete soft fabric shoe tongues automation process | The study uses image-contour simulation followed by implementation on a robotic-arm shoe-tongue line; the inputs are machine-vision image-position coordinates, and the control combines reinforcement learning with a three-convolution-layer CNN and LSTM for robot-coordinate adjustment. | Evidence is from a real production-line implementation, but the supplied report does not establish independent replication or performance across multiple sites or production settings; this limits how broadly the results can be generalized. | The conclusions are moderately supported for the particular shoe-tongue production-line demonstration: simulation accuracy was reported, and a real run produced 509 items, 349 meeting the stated error criterion; a subset was used for validation production_results simulated_accuracy training_validation_split. | Simulation testing: testing accuracy varied by activation count; it was 61.43% for N = 8, 80.77% for N = 16, 88.23% for N = 32, 92.43% for N = 64, 94.04% for N = 128, and 92.96% for N = 256 Testing accuracy by activation count. | 10.1016/j.jmsy.2020.07.001 | Verified against full text - Included |
| Borrell (2023) | Cooperative human–robot polishing for the task of patina growing on high-quality leather shoes | The paper describes a staged prototype study, from worker-interview-based requirements through a laboratory mock-up to factory validation, and gives the principal system inputs and procedures, including manually recorded paths, configurable polishing parameters, vision-based shoe localization, and robot force control. | The usability evidence is limited: six people at one factory participated, including only two patina operators and four engineering testers without patina-handwork experience; the participant table confirms the small and mixed-experience sample of six users. | The conclusions are partly supported: production-line use for three months and the reported approximately 25% operator productivity increase support the practical feasibility/productivity claim, while the reported quality success is limited to the first stages of the process Production-line use and productivity reported quality outcome. | Validation: The system was tested in the factory by six people, including two patina operators and four engineering testers; participant characteristics are summarized for Users 1–6. | 10.1007/s00170-022-10620-6 | Verified against full text - Included |
| Rahman (2026) | Human-Centric Industry 5.0 for Sustainable Business: Implementation Challenges and Strategies | The study uses a literature review and semi-structured interviews with Bangladeshi footwear-industry experts to identify implementation challenges and strategies, then ranks them with BWM and Fuzzy VIKOR. | The authors acknowledge that the analysis relies on a small expert group and that larger expert contributions could support broader application of the conclusions small_expert_panel. | The conclusions about the leading challenges and strategies are supported by the reported rankings for Bangladesh's footwear-industry case; sensitivity analysis also supports the robustness of the top strategy under the variations tested. conclusion_claims challenge_weights strategy_values sensitivity_analysis | Challenges and strategies were systematically prioritized with BWM and Fuzzy VIKOR using assessments from 10 footwear-industry experts; the panel's reported experience ranged from 10 to 17 years combined BWM–Fuzzy VIKOR evaluation using 10 experienced experts | 10.1002/bsd2.70342 | Verified against full text - Included |
| Borrell (2024) | Optimization of the pick-and-place sequence of a bimanual collaborative robot in an industrial production line | The study evaluates a BILP sequence optimizer on two shoe models using 500 trays with randomized piece positions in the robot workspace; it describes the task workflow, operational constraints, implementation in R/lpsolve, and collision-avoidance strategies sufficiently to understand how sequences were generated and executed 500 trays and randomized inputs workflow model implementation operational constraints collision handling. | Findings are limited to two shoe models, 500 randomized tray cases within the robot workspace; validation across more piece counts, shoe models, and pick-and-place systems remains future work. | The results provide reasonable support for feasibility and computational speed on the specific tested setup: 500 randomized trays across two shoe models produced valid solutions, with reported mean sequence-calculation times near 0.02 seconds per tray 500 tested cases runtime results runtime table. | Validation: 500 randomly positioned trays across two shoe models were evaluated, and the paper reports valid optimal trajectories for all evaluated cases. | 10.1007/s00170-023-12922-9 | Verified against full text - Included |
| Saraçoğlu (2021) | Minimizing makespan and flowtime in a parallel multi-stage cellular manufacturing company | The study design, case scale, deterministic assumptions, input data, three-phase workflow, GA variants, and scheduling implementation are described sufficiently to understand how the results were produced; product-level inputs and cell assignments are also provided. | The evidence comes from one shoe-manufacturing company, with six cell groups and 20 products, so external generalizability is uncertain. | The conclusions are supported for the modeled shoe-manufacturing case: the paper reports comparative scheduling results and identifies a best solution with makespan 57.02 and total flowtime 143.79 for that solution and reports significant effects of worker level, objective, and model on makespan and flowtime. | Evaluation setting: A shoe-manufacturing case study with six cell groups, three stages per cell, and 20 products processed in each stage | 10.1016/j.rcim.2021.102182 | Verified against full text - Included |
| Intalar (2021) | Towards Industry 4.0: Digital transformation of traditional safety shoes manufacturer in Thailand with a development of production tracking system | The methods are described sufficiently to understand the study's broad evidence base: a qualitative inductive case study combining an executive/partner interview, three days of shop-floor observation, and researcher participation in developing the tracking system; the paper also identifies the system's production scope and manual and IoT data inputs. | Potential bias: The qualitative single-factory case study involved researchers in developing the system, and interviews were limited to the manufacturer's CEO and the technology partner's CTO; these features may introduce researcher or informant bias and limit transferability, though the paper does not explicitly assess these biases. | The conclusions are supported as a qualitative, case-specific account of the proposed system and reported implementation factors, but the system remained under development. | The evidence is preliminary and mainly qualitative: the study reports a prototype under development, limited checking of installed temperature sensors, pilot observations, and employee design feedback Prototype system under development Implemented devices Pilot observations Employee feedback. | 10.2478/emj-2021-0033 | Verified against full text - Included |
| Chiu (2024) | Integrating explainable AI and depth cameras to achieve automation in grasping Operations: A case study of shoe company | The study design and processing pipeline are described sufficiently to understand the basic method: manually annotate insole images, train YOLOv7 and Mask R-CNN, validate the models, and combine their outputs with depth-camera data and SVD/OpenCV processing for object coordinates and angles method_stages synthetic_dataset system_functions. | Dataset and generalizability: Training relied on a custom dataset because real insole data were scarce; the authors identify the need for a larger, more diverse real-world dataset and note lighting and shadows as untested sources of variation. | The results support a proof-of-concept for integrated insole detection and pose estimation, with over 95% accuracy reported for identifying graspable objects and 97% listed in the comparison table; limited depth and rotation checks provide additional, narrow validation. | The authors report that the integrated YOLOv7–Mask R-CNN system achieved over 95% accuracy in identifying graspable objects, with 97% accuracy reported after excluding shoe-head errors and non-top-layer insoles; the system is described as operating in real time. | 10.1016/j.aei.2024.102583 | Verified against full text - Included |
| Baranowski (2024) | Influence of 3D-printed cellular shoe soles on plantar pressure during running − Experimental and numerical studies | The study design and workflow are described clearly enough to understand how the findings were produced: five cellular topologies were compression-tested, participant force-plate trials and a scanned foot informed a deformable FE model, and the model and topologies were validated before simulated rearfoot-landing comparisons. | Generalizability is limited because the study involved only one participant and one set of test conditions; the running speed was not monitored, and the authors recommend more participants and running parameters for wider interpretation. | The results support a preliminary, model-based comparison: the tested cellular soles reduced simulated heel peak pressure relative to barefoot landing, and the rhombic sole had a relatively low peak pressure and favorable distribution among the tested designs. | Cellular compression models: FEA was compared with experimental tests across five topologies; maximum peak-force discrepancies were no greater than 3.7% in absolute value, and SEA discrepancies ranged from −1.9% to 5.4%. | 10.1016/j.bbe.2024.11.004 | Verified against full text - Included |

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| Borrell Mendez (2020) | Robotic Pick-And-Place Time Optimization: Application to Footwear Production | The methods are described clearly enough to understand the main workflow: randomized tray positions for two shoe models, 30 simulated sequences per position, timing and trajectory-success measures, CTREE analysis, and training on Manufacturer 1 with validation on Manufacturer 2 The design and inputs are described The analysis and predictors are specified. | The evidence is limited to two shoe models, with Manufacturer 1 used for training and Manufacturer 2 for validation; thus generalizability beyond these models is uncertain. | The conclusions are supported for the narrow claim that decision trees can guide sequence selection in the studied two shoe models, with reported simulation results and a limited real-system demonstration; they do not establish general performance across footwear production or real-world superiority. | Scope: simulated sequencing evaluation used 30 sequences across more than 200 piece positions (over 7,000 calculated sequences); Manufacturer 1 was used for training and Manufacturer 2 for validation sequence_evaluation_scope,models_and_training_validation | 10.1109/ACCESS.2020.3037145 | Verified against full text - Included |
| Zhang (2024) | Automatic loading method for robot guided by 3D vision for scattered and stacked shoe soles | Overall, the study design and the main data inputs and analytical steps are described clearly enough to follow how the findings were produced: it captures RGB-D point clouds, preprocesses and segments them, selects grasp targets, estimates poses with an improved Super 4PCS–TEASER procedure, and evaluates robot loading. | Scope and generalizability: validation covered three sole styles, with 80 loading attempts per scheme for each style; performance across other sole types, production lines, or sites is not established. | The reported results support the method's accuracy, speed, and grasping performance in the tested setup, including improved loading success with the scoring strategy in the reported trials. | Pose estimation: Across eight soles, mean distance error was 2.04 mm, mean angular error 2.72°, and mean estimation time 0.57 s; the table benchmarks these metrics against Super4PCS+ICP and RANSAC+ICP | 10.1088/2631-8695/ad4256 | Verified against full text - Included |
| Kashfi (2022) | A novel approach to determining piezoelectric properties of nanogenerators based on PVDF nanofibers using iterative finite element simulation for walking energy harvesting | The study's methods are described sufficiently to follow the main workflow: a PVDF nanofiber device was tested under cyclic impacts, then an FE model was iteratively calibrated against experimental voltage-time data; the fitting procedure specifies RMSE, SOBOL design generation, and genetic-algorithm minimization experimental_characterization impact_test_setup repeatability optimization_procedure. | The main concern is limited external validation: the model is checked against a low-cycle impact experiment, repeated only three times, while the shoe-insole/walking performance is assessed computationally rather than demonstrated in a walking study limited_validation,repeatability,no_walking_experiment. | The conclusions are partially supported: experimental impact-test results were used to compare with the FE model, and the authors report reasonable agreement; however, the shoe-insole optimum and 15.1 V output are numerical predictions, not reported measurements from walking tests. | Repeatability: the impact experiment was repeated three times, and the median response was used | 10.1177/1528083720926493 | Verified against full text - Included |
| Kim (2022) | Robot-Based Automation for Upper and Sole Manufacturing in Shoe Production | Methods: Upper gauge-line paths were acquired with a 3-D digitizer and shoe-last turning device and transformed into robot coordinates; sole topline XYZ data were acquired by a 3-D scanner and transformed into robot paths for cementing upper_method sole_method. | Potential sources of bias and uncertainty include limited testing on one shoe and qualitative roughing assessment by a company engineer; the text does not report independent or blinded assessment or objective comparative testing single_shoe_experiment roughing_quality sole_limitations. | The conclusions are supported for the demonstrated testbed and tasks: experiments verified performance on a demonstration line, and the sole cementing result was reported as successful verified_demonstration sole_result. | The proposed upper- and sole-manufacturing systems were experimentally tested on an automated production testbed and their performances were experimentally verified. | 10.3390/machines10040255 | Verified against full text - Included |
| Turner (2019) | Sustainable production in a circular economy: A business model for re-distributed manufacturing | The supplied excerpt describes the study design, input data, MAA labeling and test protocol, image processing, transfer-learning/CNN workflow, cross-validation, held-out evaluation, and statistical comparison clearly enough to follow how results were produced. | The supplied text acknowledges small sample size, mitigated with augmentation and transfer learning, and limits model applicability to rubber, Arctic Grip, and Green Diamond outsoles; the dataset has 266 samples and a 10% holdout test set, so generalizability remains uncertain. | The conclusions about classifying tested rubber, Arctic Grip, and Green Diamond footwear are supported by the reported held-out test results, including a best F1-score of 0.89; the image-type comparison also supports the limited conclusion that outsole and heel/toe images performed similarly. | Held-out evaluation: the best model (wet MAA, outsole images, Xception) achieved accuracy 0.85, precision 0.84, recall 0.94, and F1-score 0.89; the paper also reports F1-score 0.89 and AUC 0.91. | 10.3390/su11164291 | Verified against full text - Included |
| Silvestre (2022) | Implementation of a Lean Manufacturing and SLP-based system for a footwear company | A single footwear-company case study used historical company information and an ARENA simulation of production from leather receipt through packing; the authors list controllable and uncontrollable inputs, state that station time series were checked by sensitivity analysis, and compare the current model with three staffing/layout scenarios. | The proposal was not implemented in practice; the reported improvements are simulation-based, so real-world effectiveness remains unverified The initial goal of this work was to actually implement the proposal but, due to the pandemic, only simulations can be provided for the moment. | The conclusions are supported as simulation-based projections: the reported model indicates improvements in fulfillment (94.43% to 100%), defective products (6.22% to 3.13%), and productivity (38% variation). | Validation approach: ARENA simulation and economic evaluation, with station time-series validated through sensitivity analysis; the proposal was not implemented in practice, so the findings are simulation-based. | 10.1590/0103-6513.20210072 | Verified against full text - Included |
| Gracia (2017) | Robotic manipulation for the shoe-packaging process | The paper presents a feasibility demonstration on two robotic platforms, with described hardware and sensing inputs, Kinect-based object detection, grasp planning, collision-aware motion planning, and force-controlled response; the procedural account is sufficiently detailed to understand the main approach (study_design, experimental_scope, platform_hardware, sensors, object_detection_method, grasp_method, motion_planning_methods, collision_force_method). | The evidence is limited to two experiments on two platforms, so broad generalization of effectiveness is not established by the reported demonstrations The paper presents two experiments on two different platforms. | The conclusions are partly supported: demonstrations on two platforms support the limited claim that the proposed components and shoe-packaging tasks are feasible, but the reported evidence is mainly qualitative and does not establish general effectiveness, production-scale robustness, or productivity gains the experiments cover two platforms demonstrated force-control behavior grasping tested with two hands. | The approach was evaluated through qualitative experiments on two robotic platforms: obstacle-avoiding object transport and force-controlled interaction were demonstrated, and grasping was tested on two dexterous hands with equivalent results reported Two-platform experiments and grasp tests. | 10.1007/s00170-017-0212-6 | Verified against full text - Included |
| Sarlak (2026) | Current strategies and priorities for diabetic footwear design and production: a cross-European exploratory survey of clinicians and shoemakers | The design, survey inputs, and analysis are described clearly enough to understand how the exploratory findings were produced: two online questionnaires (26 manufacturer and 14 clinician items) were analysed using descriptive statistics and inductive thematic analysis, with ranking items ordered by median and quartiles as tie-breakers the study used a cross-sectional survey questionnaire_methods) [questionnaire_content clinician_questionnaire analysis_methods ranking_method. | Possible participation bias toward more research-oriented organisations may limit generalisability. | The conclusions are supported as exploratory descriptions: the reported manufacturer and clinician priorities and adherence barriers underpin the stated partial alignment and gaps. | The findings are exploratory and descriptively analysed; rankings were summarized by median and quartiles, and open-text responses were analysed thematically, with findings considered alongside literature and guidelines descriptive_analysis ranking_method correlated_with_literature | 10.1007/s00592-026-02669-6 | Verified against full text - Included |
| Amorim (2025) | Development and Evaluation of a Piezoelectret Insole for Energy Harvesting Applications | The study is a clearly described laboratory proof-of-concept: it specifies fabrication and charging conditions, an eight-sensor insole arrangement, a solenoid gait simulator applying approximately 10 kgf, and testing at four steps per second for 25 minutes; waveform metrics, RMS voltage, and loaded output are described. | The main limitation is proof-of-concept testing only on a controlled mechanical gait simulator: the authors acknowledge it does not capture human-gait variability, and human testing is still needed to validate durability, comfort, and energy yield. | The conclusion that the prototype can generate electrical pulses under controlled compression is supported by the reported 5 V to over 13 V pulses under an approximately 10 kgf simulator load; the approximately 3 V RMS and 900 μW output are calculated/estimated values, not evidence of a demonstrated powered wearable system. | Controlled simulator evaluation: four steps per second, approximately 10 kgf combined piston load, and 25 minutes of testing; the authors report negligible degradation in voltage amplitude, waveform shape, or response time under these conditions test_conditions repeatability_result | 10.3390/electronics14214254 | Verified against full text - Included |
| Román-Ibáñez (2018) | Online simulation as a collision prevention layer in automated shoe sole adhesive spraying | Study design and inputs: The authors tested the simulator on a real shoe-sole adhesive-spraying cell, using laser-scanned sole data processed into CAD paths; they created two intended 200-path groups, with errors injected into paths in the problematic group to induce collisions. | The reported accuracy is 0.9575, evaluated on paths from a shoe-sole cell with injected errors in the hazardous-path set; therefore the evaluation provides limited evidence about other cells, tasks, or naturally occurring collision cases test_design single_cell_test. | The conclusions are supported for the tested static shoe-sole cell: the paper reports fast simulations and a confusion-matrix accuracy of 0.9575, consistent with 383 correct classifications out of 400 in the table. | Validation design: Two sets of 200 paths each were tested: one without problems and one containing collisions or unreachable points. | 10.1007/s00170-017-1257-2 | Verified against full text - Included |
| Forlini (2025) | Smart automation in luxury leather shoe polishing: a human centric robotic approach | Study and methods: The work develops and tests a collaborative robotic polishing cell, specifying UR5e equipment, CAD-designed trajectories, and force and speed controls; the force was selected after attempts and the reference speed by trial and error. | Findings are preliminary: quality and process results are reported for four test shoes, with Likert-scale evaluation by the company's chemical laboratory; some values are withheld, limiting independent scrutiny and the strength of quantitative conclusions. | The conclusion that robotic polishing is feasible is supported by tests on several shoes, reported quality evaluations and contact-force measurements; the evidence is a limited feasibility demonstration rather than a broad validation. | Evaluation and validation: Four shoe tests were assessed on visual appearance, touch, cracking, 72-hour ageing and second-hand polishing; the company chemical laboratory scored these criteria on a 1–5 Likert scale, with some specific values undisclosed. | 10.1080/0951192X.2024.2421313 | Verified against full text - Included |
| Castelli (2021) | A feasibility study of a robotic approach for the gluing process in the footwear industry† | The feasibility-study design, STL/CAD input, trajectory planning, force-control method, and test conditions are described sufficiently to follow how the experiments were conducted . | Potential bias and limitations: deposition quality was assessed partly by eye, with no visual system to measure glue-strip geometry, so quality conclusions are not supported by objective geometric inspection. | The conclusions are supported for the prototype's demonstrated feasibility and the comparison of the two layouts: the mobile-extruder cell reached 200 mm/s with limited contact loss, while the mobile-shoe layout showed detachments and requires lower speeds. | Mobile extruder: Reached 200 mm/s; contact-force variability increased from 100 mm/s, with 0.2% contact loss only at 200 mm/s | 10.3390/robotics10010006 | Verified against full text - Included |
| Kim (2026) | Shoe-CLIP: Attribute-Based Semantic Similarity Evaluation With Explainable Evidence for Sneaker Design | The methods are described sufficiently to understand the main evaluation: sneaker images and attribute captions were split into training and test sets; technical evaluation used 4,976 image pairs with an attribute-based ground-truth score; similarity was computed from cosine similarity, and models were compared with nonparametric tests The unit of analysis is a pair of sneaker images and their design-attribute representations, not respondent-level questionnaire items. | The designer-alignment evidence is preliminary: seven designers rated eight pairs, including only one senior designer; the authors caution that the sample and number of pairs do not establish definitive expert consensus or conclusive superiority. | Shoe-CLIP's lowest reported absolute errors support better alignment with the attribute-based benchmark and, preliminarily, with the designer ratings in the tested sneaker-image sets. | Technical similarity benchmarking: across 4,976 image pairs, Shoe-CLIP had MAE 0.169, MSE 0.043, and Pearson r = 0.471 against attribute-based ground truth; the table reports the comparison with CLIP, VGG, SSIM, and LPIPS Shoe-CLIP's technical results technical comparison. | 10.1109/ACCESS.2026.3711993 | Verified against full text - Included |
| Negre (2024) | Prediction of footwear demand using Prophet and SARIMA | The study compares Prophet and SARIMA in a retrospective forecast for one shoe model (P1), using a company's historical sales data; the full dataframe has 1,283,541 rows, but the company and data are confidential single_product_scope. | The findings are exploratory rather than broadly generalizable: they use one anonymized company's data and predictions for only one shoe model, and the authors state that additional product-level forecasting and testing remain future work. | The conclusions are partly supported, but with substantial methodological and reporting limitations: the tables report a Prophet advantage in annual accuracy and SARIMA advantages on some monthly-distribution KPIs and execution time, supporting a cautious, case-specific comparison. | Evaluation reported: Prophet and SARIMA are benchmarked on P1 using multiple error and accuracy KPIs. | 10.1016/j.eswa.2024.124512 | Verified against full text - Included |

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| Amjad (2022) | Optimizing Production Efficiency in Pakistani Shoe Manufacturing: A Simulation-Based Analysis | The study uses a discrete-event simulation of the 19-process lasting department in one firm, based on time-study cycle-time data; it reports 40 observations per process and distribution fitting in Minitab before simulation in AweSim study_design cycle_time_collection distribution_method. | The findings have limited generalizability: only the lasting department was modeled, not the other departments or their flows. scope_limit | The simulation results support the conclusion that the proposed plans can improve modeled productivity: plan I produces 701 units versus 700 currently, and plan II produces 716; the reported t-tests find significant productivity differences. | The study evaluated simulation-based process improvements using 40 cycle-time observations per process and fitted probability distributions; proposed plans combined workstations while retaining process orientation data_collection workstation_combinations. | | Verified against full text - Included |
| Akhtar (2023) | Prioritisation of criteria for sustainable and agile global manufacturing outsourcing partner selection using simulation based stochastic fuzzy PIPRECIA method | The study is a single Indian footwear-company case study; 19 criteria were selected from an initial 24 through literature review and discussion with five procurement experts, and ten experienced company decision-makers supplied survey ratings case_study_design. | Potential sampling and organizational bias: the ten respondents were recruited by snowball sampling from a single footwear company, and the authors describe the responses as few; they acknowledge that this limits precision and generalizability. | The conclusions are partly supported: the reported category weights support the finding that agility is the highest-priority category in this case. | The criteria were evaluated using F-PIPRECIAS and simulation-based SF-PIPRECIAS, with rankings and weights compared for all 19 criteria in the comparison table; SF-PIPRECIAS used 100 simulated ratings per criterion. | 10.1590/0103-6513.20230035 | Verified against full text - Included |
| Devireddy (2026) | Reducing Carbon Emissions in Shoe Manufacturing Through Digital Twin-Enabled Project Management † | The study uses a before-and-after Tecnomatix Plant Simulation case study of an eight-hour shoe-production line, identifies stitching as the bottleneck, and tests adding a parallel stitching machine. | The main limitation is that the claimed benefit is based on a virtually tested, single process change in an 8-hour simulation; real-time sensor data collection is described as future work, and no operating-line validation or uncertainty/sensitivity analysis is reported. | Partially supported: the simulation and tables indicate higher modeled output and lower energy intensity after adding a stitching machine, but reported throughput values conflict between the narrative and Table 5. | Baseline versus modified-layout simulation: stitching was identified as the bottleneck, and storage time was reported as 84.06%; the narrative reports throughput rising from 230 to 450 units per 8-hour shift and value-added time rising from 7.96% to 21.71% reported_throughput reported_improvement. | 10.3390/engproc2026130003 | Verified against full text - Included |
| Hernández-Vázquez (2025) | MULTI-OBJECTIVE OPTIMIZATION OF THE BUFFER ALLOCATION PROBLEM CONSIDERING THE OVERALL EQUIPMENT EFFECTIVENESS INDICATOR | Study design and inputs: A real, unreliable women's footwear stitching line was modeled with nine stations and seven buffers; the station and inspection tables specify process, failure, repair, and quality inputs. | The main limitation is external validity: results come from one footwear stitching case, and the authors identify other line structures and optimization methods as future work. | The reported optimization results support the conclusion that, in this footwear-line case study, lower buffer costs generally accompany lower OEE: the solutions show 80.40% OEE at $5,300 versus 78.19% at $700, consistent with the stated trade-off the optimized solutions show this trade-off and the paper describes OEE decreasing as cost decreases. | The meta-model was checked against simulation for 10 randomly selected combinations; the average absolute error was 0.819%, below the stated 6% criterion with validation error results | 10.23055/ijietap.2025.32.5.11019 | Verified against full text - Included |
| Zhang (2026) | Teaming Finite Element Analysis and Deep Learning to Advance Inverse Design of Metamaterial With Adaptive Pressure Response in Footwear Design | The study is a computational inverse-design case study: it uses plantar-pressure data, FEA-generated mechanical responses, and a multimodal CNN to predict rod radii, then validates designs with forward FEA against a prescribed deformation target. | Small dataset and validation: Only 42 FEA-ready samples were available; the 9-sample test split was used only in preliminary exploration, while the final model was trained on all 42 samples without a testing loss. | The reported results support the narrow computational conclusion that DL-optimized designs improved FEA deformation agreement with the prescribed target versus the under-optimized baseline in the reported cases, with MSE reductions of about 48%–81% in Table 4 reported_reductions reduction_table. | Comparative FEA evaluation: DL-optimized designs had lower MSE than under-optimized baselines, with reported reductions of 48%–80% across the evaluated participant/material cases; Table 4 reports the case-level node counts and MSE values. | 10.1115/1.4071847 | Verified against full text - Included |
| Wu (2016) | An automatic shoe-groove feature extraction method based on robot and structural laser scanning | The study describes a clear technical workflow—laser scanning, level-set/weighted-PCA feature analysis, 3-D-to-2-D groove extraction, thinning, and ICP alignment—and identifies implementation equipment and software, making the method broadly understandable method_pipeline feature_analysis implementation. | The authors acknowledge that black leather, shiny surfaces, and shoes without a groove may fail reconstruction, and that the processing speed does not meet real-time requirements surface_failure future_speed_limit. | The conclusions are partly supported: qualitative results and comparison with a commercial scanner support feasibility of the proposed shoe-groove detection and reconstruction method, but do not establish broad performance across footwear or production conditions the method can "exactly detect the shoe-groove features". | Reconstruction accuracy, compared with a commercial Creaform Handyscan scan of subject II: maximum distance positive 0.22 mm; negative −0.38 mm; average distance positive 0.012 mm; negative −0.017 mm. | 10.1177/1729881416678135 | Verified against full text - Included |
| Gelaziene (2023) | Influence of the Type of Plastic and Printing Technologies on the Compressive Behavior of 3D-Printed Heel Prototypes | The study compares seven heel-material variants made by FDM, SLS, or SLA; Table 1 lists each material's printing method and reported mechanical-property inputs study_scope | The evidence is limited to 3 cm heels of one design and seven material variants; PA12 included a 50/50 mixture of virgin and previously used powder, so findings may not generalize to other designs or production conditions prototype_scope. | The findings are reasonably supported for the tested prototypes under static compression: reported results distinguish the high-load performance of PA12/SLS and photopolymer/SLA from the FDM materials, and identify TPC as unsuitable for this design. | Experimental evaluation: The compression test used a 5 mm/min speed and 50 N preload, and was repeated five times. | 10.3390/ma16051930 | Verified against full text - Included |
| Yardimci (2026) | Deep learning-based forecasting of temperature and humidity in footwear using multi-sensor data | The methods are described in considerable detail: a sweating/heated foot model was tested in three boot-lining conditions, with repeated 8-hour trials and multisensor temperature/humidity data; five forecasting models were compared using four metrics and five-fold cross-validation. | Important limits to external validity are the single simulated male size-42 foot, controlled resting conditions, and three same-production classic military boots; the study does not test real users, other footwear designs, or dynamic activity. | The conclusion that HM is a strong overall forecaster is broadly supported by the reported comparisons, but the claim that it outperforms every model in every condition is too strong: the tables contain exceptions in individual cells. | Five forecasting models were benchmarked using MAE, RMSE, EVS, and MAPE, with a reported five-fold cross-validation procedure metrics five_fold_cv. | 10.1177/18761364261433172 | Verified against full text - Included |
| Rodrigues (2021) | Assessing the compressive and impact behavior of plastic safety toe caps through computational modelling | The study clearly describes a computational assessment of a commercially supplied polymer toe cap under standardized compression and impact conditions, including material testing, constitutive model, simulation setup, and mesh refinement. | The paper acknowledges inherent simplifications in the numerical models and states that simulations are not expected to replace experimental testing; it reports compression and impact agreement with experiment, with errors of about 5.5% and 6.8%, respectively. | The conclusions are reasonably supported for the tested toe cap and the reported compression and impact conditions: experimental and simulated measurements differed by 5.4% and 6.8%, respectively, and the authors report convergence between the two finest meshes. | Compression: At 15 kN, experimental and simulated displacements were 6.12 mm and 5.79 mm, respectively, with a reported maximum error of 5.4%. | 10.3390/polym13244332 | Verified against full text - Included |
| Xu (2025) | Wear Resistance of Additively Manufactured Footwear Soles | The study compares 26 printed tread samples—13 geometries per material—using controlled sliding-abrasion tests and FEM; the material, printing, and test setup are described in the text and tables.26 samples, two materials, and 13 geometries per material printing and post-processing details test setup and calibration details | Sample and manufacturing variability: The study acknowledges variation across SLA samples and possible material, post-processing, and printing-parameter effects; it also attributes an extreme SLA result tentatively to printing or curing defects, but these factors are not disentangled experimentally. | The comparative conclusions are supported for the tested samples and abrasion conditions: TPR had lower reported mean weight loss, while SLA resin had higher mean COF and first-cycle temperature change. | Abrasion performance: Across 26 samples (two materials and 13 geometries), TPR had 27.3% lower mean weight loss than SLA resin (0.0208 vs 0.0265 g) | 10.3390/lubricants13020089 | Verified against full text - Included |
| Wang (2025) | 3-D Reconstruction and Trajectory Planning for Real-Time Shoe Upper Glue Spraying System | The study design and pipeline are described sufficiently to follow how point clouds are acquired, registered, and converted into spraying trajectories; the paper also specifies some preprocessing and hardware details system_and_acquisition registration_pipeline preprocessing_parameters hardware. | Findings are supported by repeated testing and some production-line verification, but confidence is limited by narrow shoe-type and fixed-posture testing, operator-defined benchmarking, manual parameter settings, and unavailable underlying data tests were conducted on sports shoes and skate shoes posture was fixed an experienced operator's trajectory was the benchmark neighborhood size was manually set by region underlying data are not publicly available. | The conclusions are reasonably supported for the tested setup and samples: reported registration and trajectory comparisons, repeated trials, and actual spraying tests provide quantitative evidence for the proposed method's accuracy and speed registration_results ablation_results trajectory_repeats trajectory_accuracy spray_validation spray_error. | Registration: Improved TEAR achieved RMSE 0.43 mm, processing time under 1 s, and more than 50% valid correspondences in the 20,000-point scenario; in the coarse-plus-fine ablation, RMSE fell to 0.401 mm, with fine-tuning taking 0.374 s registration_metrics registration_ablation | 10.1109/TIM.2025.3623792 | Verified against full text - Included |
| Luximon (2020) | Sizing and grading methods with consideration of footwear styles | The study design and analytical workflow are reasonably clear: it simulates three sizing/grading approaches from 3D foot scans, describes the key anthropometric/PCA inputs, compares predicted with observed foot shapes using error, and reports style-level and validation results. | The sample was restricted to Chinese women aged 18–60 screened to exclude foot and lower-limb illness or injury, limiting generalizability; the text also inconsistently says data from 550 participants were used although 450 model-building plus 55 validation participants are reported. | The modeling results support the narrower conclusions that PCA methods reduce prediction error relative to M1, and that prediction error differs significantly across footwear styles; M3's errors are close to M2's. pca_error_comparison pca_error_values style_significance style_error_values m3_error_comparison | The study evaluates three methods (M1 anthropometric, M2 PCA, and M3 anthropometric measures with PCA grading) using predicted-versus-actual 3D foot-shape error. | 10.1016/j.ergon.2020.102960 | Verified against full text - Included |
| Méndez (2021) | Conceptual and preliminary design of a shoe manufacturing plant | The study design and analytical approach are described at a high level: expert knowledge is encoded in an expert system and used with AnyLogic discrete-event simulation to model direct-injection and mounting-and-cementing plants; the stated inputs include process dependencies and mean task times. | Potential bias: results rely on expert-derived inputs, including knowledge supplied by the coauthors, and company-assisted task-time estimates; the company is reported to have validated task and sub-task times, but independent validation is not described. | The conclusions are reasonably supported as results of the two simulated plant designs: the reported worker-productivity figures favor direct injection over mounting-and-cementing in the modeled scenarios (36.60 vs. 28.08 shoes per worker per shift; stated as 30.34% more productive). | Direct-injection simulation: 787 pairs produced in 8 working hours; average product time 45.925 min; 11 products remained queued, estimated to require 13.017 min to finish | 10.3390/app112211055 | Verified against full text - Included |
| Pagano (2020) | A vision guided robotic system for flexible gluing process in the footwear industry | The study evaluates a vision-guided gluing-machine prototype through calibration tests and tests of the overall gluing trajectory A wide testing activity was used to analyse the errors resulting from the execution of the whole gluing process. | The study acknowledges that the low-resolution Kinect sensor limits performance and that a better sensor could improve results. sensor_resolution | The conclusions are reasonably supported as prototype-level evidence of feasibility and suitability for the tested gluing task: calibration and 2D error tests are reported, alongside trajectory tests on soles. | Calibration: error below 5 mm across tests using 30 marker positions | 10.1016/j.rcim.2020.101965 | Verified against full text - Included |
| Pancu (2024) | Inverse Kinematics Proposal to Automatize the 3D Scanning of Handball Shoes by Using a Robotic Arm with 3 Actuated Joints | The paper outlines the trajectory, arm geometry and inverse-kinematics approach, and reports scans of two shoe models plus simulated scanning trajectories and times (20 s for shoe A; 17.8 s for shoe B). | The main limitation is that the automated approach is supported by virtual simulations for only two shoe models; the text proposes manufacturing the arm but does not report physical validation or quantitative accuracy and repeatability testing the simulations the proposed manufacture. | The proposed trajectory and its feasibility are supported by a mathematical model and virtual simulations on two shoe types, with simulated path times of 20 s for shoe A and 17.8 s for shoe B; scanned 3D models were also processed (both shoes). | Simulated trajectory-following times: shoe A, 20 s; shoe B, 17.8 s. | 10.3390/app14010297 | Verified against full text - Included |
| Zhang (2023) | Research on the path extraction method of shoe upper grinding based on 3D vision | The study design and pipeline are described clearly enough to understand how the trajectory is produced: RGB-D acquisition from marked shoes, point-cloud filtering/smoothing and registration, RGB-based feature extraction, slicing/intersection, and NURBS fitting are specified, with a platform and robot described. | The study acknowledges uncertainty from camera accuracy, lighting, RGB edge-point loss, and sensor and hand–eye calibration errors; it says the resulting error is acceptable, but does not quantify or comprehensively assess these sources. measurement variability and RGB extraction error are acknowledged | The reported results support the narrower conclusions that the method generated trajectories with lower average error than the compared methods (0.9 mm overall) and shorter average runtime (13.85 s) in the experiments. | Accuracy: The proposed method's overall average error was 0.9 mm, compared with 1.29 mm for PCA/PCPA and 2 mm for NPR/NPCR; accuracy was assessed against a reference curve using 50 sampled test points per method and average nearest-point Euclidean distance. | 10.1088/2631-8695/ad0f77 | Verified against full text - Included |

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| Shaulian (2022) | A novel graded-stiffness footwear device for heel ulcer prevention and treatment: a finite element-based study | The study uses a previously reported and validated finite-element framework to compare ten heel-support variants—five configurations under flat and total-contact-insole geometries—on a 3D CT-derived model of one male subject's left heel study design, model_geometry, support_variants. | Potential bias/uncertainty: Findings are based on a finite-element model using literature-derived material properties and boundary conditions for one non-diabetic heel, so they may not represent diabetic or patient-specific biomechanics; clinical validation in a pathological population is still needed this limitation is acknowledged. | The modeled findings support the conclusion that graded-stiffness configurations distribute and reduce tissue stress more effectively than the compared insole approaches in the two modeled regions, but only as a biomechanical result of the finite-element study. | The study computationally compared graded-stiffness (GS) and GS-with-hole supports against existing offloading solutions, measuring total stress-concentration exposure (TSCE) in high-risk and peripheral tissue volumes; both GS designs substantially reduced TSCE in both volumes versus existing solutions compared with the existing offloading solutions TSCE outcome measure. | 10.1007/s10237-022-01614-0 | Verified against full text - Included |
| Gomez-Hernandez (2024) | Development of an Integrated Robotic Workcell for Automated Bonding in Footwear Manufacturing | The engineering methods are described sufficiently to follow the workcell design and operation: the paper specifies three robots, five RGB-D cameras, a laser scanner, and the role of the GeoGrasp algorithm in calculating grasp points three robots, vision system, scanner/toolpath, grasping algorithm. | Findings demonstrate feasibility in a research prototype, but the study does not establish performance in routine production; reported cycle time and failure rate are approximate and may vary by outsole type and movement optimization prototype_scope performance_approximation performance_variability. | The conclusions are reasonably supported as a demonstration of feasibility: reported assembly precision and synchronized movement results, alongside adhesive-joint tests across material combinations, give empirical support for automating the tested bonding process assembly_precision synchronization_error adhesion_validation adhesion_results_table. | Workcell performance: operation averaged 1′31″ with one outsole and 1′25″ with two, with a 2.3% failure rate in both configurations; tests used only one or two outsoles at a time, and the authors describe the time and failure-rate figures as approximate and dependent on sole type and optimization. | 10.1109/ACCESS.2024.3350441 | Verified against full text - Included |
| Ruzafa-Silvestre (2022) | Robotised atmospheric plasma treatment to improve the adhesion of vulcanised and thermoplastic rubber materials for a more sustainable footwear | The study design, plasma treatment variables, characterization methods, and standardized adhesion-test procedure are described sufficiently to follow how the experiments were conducted; the reported surface measurements and qualitative adhesion findings support the conclusions, although numerical T-peel results are not supplied here and the per-sample adhesion protocol uses only three test pieces. | The study reports means and typical deviations from three test pieces per sample, so the small replicate count limits confidence in precision and reproducibility [replicates]. | The conclusions that plasma treatment improves adhesion for the tested SBR/SBS joints, with 0.05 m/s performing best, are directionally supported by the reported results, but the strength of support is limited because the supplied tables omit the peel-strength values and statistical comparisons needed to verify the size and significance of the effect. reported improvement and best speed triplicate bond-strength method | Adhesion performance: Both plasma treatments improved bond strength for SBR and SBS, with 0.05 m/s reported as the best speed; treated joints were reported to exceed minimum footwear quality requirements. | 10.1016/j.ijadhadh.2021.103010 | Verified against full text - Included |
| Shih (2020) | A biomechanical investigation of athletic footwear traction performance: Integration of gait analysis with computational simulation | Study design and methods: The paper clearly describes the integrated gait-analysis/FE approach, the three gait phases and ten tread designs analyzed, the use of plantar-pressure inputs, and reaction force and real contact area as outcomes; Table T1 supplies Ogden foam parameters for the shoe materials. | The authors acknowledge substantial limits to generalizability: loading came from one subject, only dry and flat concrete was modeled, friction was fixed at 0.6, medial-lateral and vertical forces were omitted, and the analysis considered static friction only single-subject loading, surface conditions, fixed friction, ignored force directions, static friction. | The conclusions are reasonably supported for the tested designs and simulated dry-walking conditions: the FE results correlated strongly with mechanical-test measurements, and greater real contact area was associated with greater reaction force. | Experimental validation: For four tread designs, FE-predicted reaction force correlated strongly with mechanically measured coefficient of friction at loading response ($R^2$ = 0.936), mid-stance ($R^2$ = 0.920), and push-off ($R^2$ = 0.935) strong correlations. | 10.3390/app10051672 | Verified against full text - Included |
| Wu (2025) | AI-Driven Supply Chain Transformation in Industry 5.0: Enhancing Resilience and Sustainability | The study uses a two-stage expert-based prioritization design for AI imperatives in China's ready-made-garment and footwear industries: 40 experienced specialists provide initial ratings, then 14 experts assess relationships and priorities; the initial survey uses a nine-point Likert scale and Pareto screening. | The main potential biases are the subjective selection of expert participants and the limited, China-specific RMG and footwear focus, which constrain representativeness and generalizability; the authors also acknowledge that hypothetical and literature-based evidence may not reflect implementation in practice and that implementation barriers were not fully captured the expert panel was selected subjectively; the findings may not generalize beyond the studied industries and country; the evidence may not capture real-world implementation; cultural, organizational, or technological barriers may be overlooked. | The conclusions are partially supported: the study provides expert-based prioritization of AI imperatives for China's RMG and footwear supply chains, but does not report direct evidence that implementing them improved resilience or sustainability; it frames its aim as evaluating priorities for implementation rather than measuring intervention outcomes (the study develops a framework to evaluate AI priorities). | The findings are evaluated through Pareto analysis and Bayesian BWM, using expert ratings and a second-stage assessment by 14 experts; the probabilistic model was estimated with MCMC/JAGS. | 10.1007/s13132-024-01999-6 | Verified against full text - Included |
| Majeed (2017) | Internet of things (IoT) embedded future supply chains for industry 4.0: An assessment from an ERP-based fashion apparel and footwear industry | The study describes a mixed-method assessment using questionnaires and direct observation of SAP ERP transactions, with 30 SAP consultants and 10 apparel/footwear users; it reports 15 direct observations in the collection account but later says the summarized data came from 10 observations, leaving an inconsistency in the observation count. | The evidence is exploratory: the study used 30 valid survey responses from SAP consultants and users, with a 40% response rate among external users, making representativeness and nonresponse bias concerns; the sample is narrowly tied to SAP and apparel/footwear operations. | The findings offer limited, preliminary support for the narrower conclusion that manual ERP transactions take time and that users see potential in RFID/BAPI automation: the study reports process observations and survey responses, and T2 records run-one timings and automation indicators. | ERP process evaluation: inbound and outbound transaction times were measured in two iterations; the authors report variation between runs and increased time when errors rose. | | Verified against full text - Included |
| Oliver (2021) | Towards footwear manufacturing 4.0: shoe sole robotic grasping in assembling operations | Study design and inputs: A physical robotic-workcell evaluation tested 20 soles in 10 trials each (200 tests), classifying samples by flexibility. | The authors identify important limitations: the contour-based 2D representation loses interior geometric information, and grasping is less successful for highly flexible soles and soles with heels, particularly during the aerial rotation-station grasp using a partial lower view. | The conclusions are supported for the tested prototype and the stated scope of low- and medium-flexibility, no-heel soles: reported success was 100% at the conveyor and 95% at the rotation station for that subgroup reported success by heel status. | Real-world evaluation: 20 sole models tested 10 times each (200 tests). | 10.1007/s00170-021-06697-0 | Verified against full text - Included |
| Zhang (2026) | Unveiling the resolution-induced variability in product carbon footprints: Evidence from multi-level electricity consumption data in footwear manufacturing | The study design, data inputs and main analytical procedures are described sufficiently to follow how the reported comparisons were produced: it evaluates four electricity-data sources for two footwear products in one factory, reports equipment/process coverage and monitoring conditions, and describes carbon accounting, sensitivity analysis and uncertainty simulations. | Potential bias and remaining limitations: Measurements were taken under stable conditions and may omit start-up/shutdown conditions or electricity-source information; because true values are unknown, the methods cannot be directly validated for accuracy. | The conclusions are reasonably supported for the two products and factory studied: the measured, nameplate, and factory-average approaches produced materially different estimates, and the reported uncertainty analysis supports the stated ranking of variability. | Comparative benchmarking: Measured values were lower than nameplate values for both shoe models, with measured-to-nameplate ratios of 34.2%–54.7% for AS1 and 46.5%–70.9% for AS2; the study measured all 81 AS1 and 70 AS2 equipment items across their reported process lines and processes as described. | 10.1016/j.resconrec.2026.108938 | Verified against full text - Included |
| Bettahar (2022) | Robotic Threading from a Gel-like Substance Based on Impedance Control with Force Tracking | The study design and methods are described sufficiently to understand the experimental setup, the adhesive input, online stiffness estimation, and the comparison of impedance force-tracking with velocity control at matched final displacement described setup and comparison. | Potential bias / limitations: The findings are based on one commercial adhesive and fixed environmental conditions, so their generalizability to other materials or conditions is uncertain material_specificity environment_conditions. | The conclusions are supported by the reported experiments for the tested adhesive and comparison: the proposed method yielded higher measured fiber properties and the advantage was reported across four iterations higher measured properties repeatability four iterations. | Force tracking: 15 s response time without overshoot; force tracking error 0.0190 mN (0.95%) and position error 0.0053 mm (0.23%) | 10.1109/LRA.2021.3116697 | Verified against full text - Included |
| Jianlin (2024) | A knitted smart sneaker system based on piezoresistive strain sensing for stride counting | The sensing mechanism, peak-detection procedure, walking activities, and repeat-test analysis are described, and Table 1 reports the observed averages and standard deviations; however, the supplied methods do not establish a clear participant sample, detailed protocol, or independent reference validation, limiting assessment of robustness. | Testing involved only one foot, limiting generalization of the findings to ordinary two-foot step counting. | The conclusion that the shoe-embedded sensor can measure stride counts in the tested walking activities is supported by reported counts for normal walking and stair ascent/descent, with reliability estimates based on four test results over three weeks; support is limited to these conditions and the reported evidence does not establish accuracy against an independent reference the reported results. | Normal walking: 28 steps on average (SD 2.08) over 43 m in 60 s | 10.35530/IT.075.01.20232 | Verified against full text - Included |
| Mofatteh (2026) | Blockchain enabled sustainable packaging for carbon footprint reduction in the European footwear industry | The study design and broad workflow are described: a Python hybrid simulation uses a logistic return-behaviour model, Monte Carlo sampling, and deposit/bonus scenario analysis to estimate return, reuse/recycling, cost, and $CO_2$ outcomes; each scenario uses 30 replications, with means reported design [replications]. | The main potential bias is reliance on behavioural and friction assumptions borrowed from deposit-return and apparel analogues rather than footwear-specific observations; the numerical effects are acknowledged as exploratory, and footwear-specific pilot calibration is still needed . | The conclusions are partly supported as simulation-based, directional findings: the tables show modeled improvements in return, reuse, and $CO_2$ savings as incentives increase, including approximately 1.9 tonnes saved per 5,000 packages for the balanced configuration. | Simulation evaluation: A Python hybrid behavioural and scenario-based simulation evaluated environmental and economic performance; each scenario used 30 Monte Carlo replications, reporting means, with 95% confidence intervals available in supplementary data. | 10.1016/j.grets.2026.100401 | Verified against full text - Included |
| Calderón-Andrade (2020) | Productivity improvement through reengineering and simulation: A case study in a footwear-industry | The study design and main analytical workflow are described sufficiently to understand how the findings were generated: a discrete-event simulation compares current and proposed decorating-line configurations, using 73 operation-time observations collected during February–April 2019, fitted input distributions, and approximately 30 shift-representative replications. | The main limitation is that the proposed process was not validated against post-implementation factory data; implementation results were not disclosed in enough detail to independently assess the authors' claim of better-than-simulated performance. | The conclusions are reasonably supported for the simulated case: the reported simulation comparison favors the merged-line proposal, with about 29% higher production and up to 41% under optimization, based on 30 replications. | Simulated production, same resources: final packing output was 2,138 pairs/day for the proposed layout versus 1,661 pairs/day for the current process—about a 29% increase; utilization was also compared across activities, with gains in some activities and lower utilization in painting and flaming for the proposal as tabulated. | 10.3390/app10165590 | Verified against full text - Included |

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| Arshad (2024) | The role of big data analytics in the footwear supply chains: a multiple case study perspective | The study uses 11 semi-structured interviews with professionals from four footwear organizations in Pakistan, selected purposively; interviewee roles and experience are reported in Table 2 11 semi-structured interviews (see Tables 1 and 2 ) have been conducted with the professionals of different companies in the footwear industry operating in Pakistan. | Potential bias and limitations: findings may reflect purposive selection of experienced, mainly leading personnel from four Pakistani firms in the organized footwear sector, rather than the wider footwear workforce, other regions, or less-organized firms. | The conclusions are partly supported for the four participating Pakistani footwear firms: the study reports 11 interviews, pattern-matching analysis, and triangulation with secondary materials, and its tables summarize the participants, systems, and reported sustainability practices. | Qualitative findings: based on 11 semi-structured interviews across four footwear organizations, analyzed through thematic coding and pattern matching | 10.1108/JSTPM-12-2023-0214 | Verified against full text - Included |
| Kropidłowska (2023) | Analysis of the Impact Resistance of Toecaps by the Finite Element Method: Preliminary Studies | The study is described clearly enough to follow its main design and modeling workflow: it is a preliminary finite-element impact analysis using 3D-scanned toecap geometries, literature-based material properties, ANSYS Explicit Dynamics, and specified striker and support conditions. | The study is explicitly preliminary, and its reported findings are numerical simulations; no experimental validation or comparison is reported in the supplied text, limiting confidence in how well the model predicts real impact behavior preliminary_scope no_experimental_validation_reported computational_method. | The conclusions that the modeled stress patterns and deformations vary with toecap shape and material are supported by the reported finite-element results and T1, including the AISI 1045 stress exceeding its listed tensile-strength range the reported stress results main conclusion. | The FEM evaluation reported critical-stress locations and equivalent-stress maps; Table 4 gives displacement and equivalent-stress results for Lexan and four steels alongside steel tensile-strength ranges and was explicitly presented as a preliminary analysis. | 10.3390/ijerph20010152 | Verified against full text - Included |
| Macchion (2021) | Global–local supply chain configurations for different production strategies: a comparison between traditional and customized productions | The study uses discrete-event simulation applied to one Italian footwear company's supply chain, with initial model parameters derived from company ERP data and comparisons of traditional and customized collections simulation_design, case_data, erp_inputs. | The findings are based on one Italian footwear-company case and its two main suppliers, limiting generalizability beyond that specific supply-chain context The proposed simulation approach was tested and applied to an Italian footwear company. | The conclusions are supported for the simulated case: results favor a 70% local/30% global mix for customized production and a 50%/50% mix for traditional production, consistent with the reported scenario results for the specific case study and Table 1. | Evaluation approach and support: Discrete-event simulation was applied to a real Italian footwear-company supply-chain database, with model parameters drawn from its ERP system. | 10.1108/JFMM-12-2019-0269 | Verified against full text - Included |
| Paiva (2017) | Multiobjective optimization of mechanical properties based on the composition of adhesives | The study design and analytical workflow are described sufficiently to follow how the findings were produced: a 27-run Taguchi composition experiment measured creep rate and peel strength; an ANN fitted these data; and a genetic-algorithm MDO searched for constrained Pareto trade-offs, with Sobol indices estimated using ANN-based Monte Carlo simulation. | The main remaining concern is limited validation: the ANN is learned from the 27 planned Taguchi design points, and the described experimental check tests only one selected trade-off solution; no independent ANN test set or broad validation across the Pareto front is described. | The conclusions are partly supported: the L27 design, reported ANN error, and experimental checks on one selected trade-off composition provide evidence for the approach and its predictions in this setting 27-point_design ann_error experimental_validation creep_validation. | ANN fit: mean relative error of 3.45%. | 10.1007/s10999-015-9313-2 | Verified against full text - Included |
| Shamsuzzoha (2016) | ICT-based solution approach for collaborative delivery of customised products | The study combines a literature review with case analysis of six companies across three networks/sectors, using interviews with network personnel and business partners to elicit requirements; it then develops, implements, refines, and validates an ICT platform in those cases. | The evidence is a small, selected case assessment—six firms across three sectors, only two firms per sector—with interviews and online questionnaires; the footwear evidence is one prototype-focused use case. | The conclusions are supported for the platform's implementation and perceived usefulness in three case networks, but evidence is limited to a descriptive questionnaire assessment involving six firms; reported findings are case-specific tool evaluations rather than measured performance outcomes. | Overall assessment: The platform was assessed using online questionnaires involving six pilot firms across textile/apparel, footwear, and machine tools; the reported support is qualitative and does not include numerical performance metrics, statistical analysis, or a comparative benchmark. | 10.1080/09537287.2015.1123322 | Verified against full text - Included |
| Chang (2020) | Evaluation of smart alarm systems for industry 4.0 technologies | The study compares two multi-criteria decision methods—CEGRA and TOPSIS—to rank four IAMS software contractors for a sports-shoe manufacturing context; it is not a controlled evaluation of technology effects on production outcomes. | The authors acknowledge a narrow scope: an IAMS upgrade at a traditional shoe company, with future applicability to other industries presented as a possibility rather than demonstrated evidence. | The conclusions are supported for the narrow result that CEGRA and TOPSIS identify the same top two supplier candidates in this four-company evaluation; the tables show Company A ranked first and Company B second under both methods, although the third- and fourth-place ordering differs CEGRA results rank Company A first (0.7941) and Company B second (0.6959), followed by Company C (0.6571) and Company D (0.6565). | Evaluation basis: Ten experienced sports-shoe-industry R&D team members assessed four supplier alternatives using the study's evaluation criteria. | 10.3390/app10062022 | Verified against full text - Included |
| Liu (2020) | An improved value stream mapping to prioritize lean optimization scenarios using simulation and multiple-attribute decision-making method | The study is a single footwear-manufacturer case study combining shop-floor Taguchi experiments, simulation of two future-state VSM alternatives, and grey relational analysis to rank scenarios; its design, key inputs, outcome measures, and 90% fulfilment screening criterion are described clearly enough to understand the broad analysis. | Findings are based on one footwear manufacturer, limiting generalizability to other plants, footwear products, or settings. | The conclusions are supported for the reported footwear-company case: the selected future-state scheme reports lower WIP and higher order fulfilment than the current state, and the simulation was checked against actual-system data. | Simulation model: Current-state simulation outputs were compared with actual-system performance and reported to fall within the range of actual data, supporting the model as an optimization platform. | 10.1109/ACCESS.2020.3037660 | Verified against full text - Included |
| Lu (2025) | Parametric cushioning lattice insole based on finite element method and machine learning: A preliminary computational analysis | Study design and inputs: A preliminary computational design study used FE simulation and machine learning to optimize a parameterized lattice insole; 125 FE samples linked structural parameters to compression responses, with a 100/25 training-validation split, while gait inputs came from one healthy male volunteer. | The authors acknowledge that the work is primarily a simulation-based framework and lacks clinical-benefit validation across users; the human study involved one healthy male volunteer, limiting generalizability . | The conclusions are reasonably supported as preliminary computational findings: the reported peak-pressure reduction was accompanied by FE-to-experiment comparisons, including a 5.23% difference in peak pressure for the optimized insole reported_reduction experimental_pressure_validation. | Finite-element compression validation: experimental and simulated deformation trends were consistent; reaction-force discrepancies were 3.2% and 0.4% for samples A and B, respectively reported comparison. | 10.1016/j.jbiomech.2025.112674 | Verified against full text - Included |
| Yalçın (2025) | Footwear breathability test machine: A new method and system design for testing footwear breathability and its thermal comfort, case study on leather boot | Methods and evidence: The study design and core measurement procedures are described sufficiently to understand the production of the findings: a heated, sweating foot model simulated 8 hours of seated wear; temperature and humidity sensors recorded data, and boot, footbed, and sock weight changes were measured across three trials for each of three leather boots. | Generalisability: Only three similar full-leather military boots were tested, and the authors state that other footwear types should be tested for wider applicability. | The reported results provide preliminary, descriptive support for the device's ability to record moisture-related weight gain and temperature/humidity changes in the tested setup; each of the three full-leather boots was tested three times, and their reported absorption values are presented in the results table. | Evaluation: Three full-leather military boots were tested, with three tests per boot; measurements included sensors and weight gain. | 10.1177/15280837251346790 | Verified against full text - Included |
| Sultana (2021) | Numerical assessment of directional energy performance for 3D printed midsole structures | The numerical workflow is described sufficiently to follow how the model produces its findings: it calculates directional work from net forces and deformation using dynamic finite-element analysis with frame elements and Newmark time integration, and compares static, quasi-static, dynamic, and lattice-structure cases dynamic_method newmark_method force_calculation loading_cases. | Important acknowledged sources of uncertainty include omitted damping, specific element orientations, unmodeled geometric nonlinearity, restricting the elements to circular cross-sections, and using a forefoot-strike load; the authors note results may vary with physical properties, cross-section, or higher loads, which could cause failure these limitations are explicitly stated. | The numerical conclusions that DEP can occur in the modeled dynamic analyses are supported by the reported static/quasi-static comparisons and loading cases, but the evidence is limited to simulations and selected configurations The study verifies DEP is a dynamic process by executing static, quasi-static, and dynamic analysis for various loading circumstances. | Numerical evaluation: static, quasi-static, and dynamic analyses compared loading conditions and structures; results include directional energy performance and stress measures across 1-, 2-, and 4-element structures, ABS and aluminum, and two material volumes the study verifies DEP through these analyses comparative structure/material metrics. | 10.3934/mbe.2021224 | Verified against full text - Included |
| Mihai (2022) | Mechanical Parameters of Leather in Relation to Technological Processing of the Footwear Uppers | The experimental design and main procedures are sufficiently clear to understand how the reported mechanical measures were produced: tensile tests compared unprocessed, stitched, and perforated calfskin and two-layer samples, with Young's modulus and Poisson's ratio calculated from the tests. | Findings are limited to one calfskin and two lining materials, tested in a single direction; generalisation to other footwear materials, leather regions, or loading directions is uncertain. | The conclusions are generally supported for the tested material and processing configurations: the tables report Young's modulus and Poisson's ratio means and CVs, consistent with the stated processing and lining trends. | Experimentally evaluated results: mean Young's modulus and Poisson's ratio, with coefficients of variation, for calfskin and two calfskin/lining combinations across unprocessed, stitched, and perforated samples. | 10.3390/ma15155107 | Verified against full text - Included |
| Li (2026) | Driving Factors and the Role of Sustainable Supplier Development in Blockchain-Enabled Supply Chains: Evidence From the Fashion Manufacturing Industry | The methods are described sufficiently to understand the study's basic evidence chain: a questionnaire survey of footwear and apparel firms in Quanzhou yielded 532 valid responses from 800 firms approached; constructs used adapted multi-item measures and a five-point Likert scale; analyses used PLS-SEM, with measurement and structural assessment and 5,000-resample bootstrapping. | Generalizability: the sample is limited to footwear and apparel manufacturers in Quanzhou, Fujian; extrapolation to other regions, supply-chain tiers, or product categories is cautioned against. | The conclusions about implementation intention are generally supported by the reported path and moderation results: the tested antecedents and significant SSD interactions match the reported directions, while policy/regulatory support and the social-capital interaction are nonsignificant.main_effects_report | Evaluation approach: PLS-SEM hypothesis testing with bootstrapping based on 5,000 resamples; 532 valid questionnaires (66.50% response rate). | 10.1002/csr.70490 | Verified against full text - Included |
| Alam (2024) | Analyzing the impact of opportunistic maintenance optimization on manufacturing industries in Bangladesh: An empirical study | The study uses historical-data case studies for a Bangladeshi footwear factory and railway industry, with Python simulation optimization; it reports 100,000 iterations and minimizes estimated average maintenance cost per machine per day across three opportunistic-maintenance policies. | Potential bias/uncertainty: results depend on Weibull failure and independent-degradation assumptions, with parameters based on historical data and specialist input failure-distribution assumptions parameter basis. | The conclusions are supported for the two modeled Bangladesh case studies: the reported cost comparison identifies the two-level approach as lowest-cost and reports 16.9% and 22.4% savings over corrective maintenance in the footwear/leather and railway cases, respectively . | Evaluation approach: Simulation optimization was used to evaluate costs, with 100,000 iterations; the footwear case used three years of historical data (2021–2023). | 10.1016/j.tbench.2024.100172 | Verified against full text - Included |

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| Wang (2026) | Influence of Unit-Cell Geometry on 3D-Printed Chiral-Inspired Tubular Metamaterials: Auxeticity and Energy Absorption in Athletic Footwear Applications | The study design and core methods are described sufficiently to follow the production of the findings: nine geometries vary thickness and width while other dimensions are held constant; printed specimens undergo quasi-static compression; stiffness, SEA, and Poisson's ratio are defined; and finite-element simulations are calibrated and compared with experiment design_parameters compression_protocol performance_measurements poisson_measurement finite_element_methods. | Manufacturing-related uncertainty: printing effects were not independently investigated; calibration of the effective modulus on one reference specimen may not capture configuration-specific manufacturing variation manufacturing_variability. | The conclusions are partly supported: controlled quasi-static compression of nine geometries and a reported $R^2$ of 0.99 for the reference-sample comparison support investigating geometry-dependent mechanical behavior, but validation is explicitly described for only the 0.85 mm × 3.5 mm reference sample, not all configurations. | Model validation: The FEM was compared with experiment using force–displacement fit, peak-force error, and initial-stiffness error; the reported $R^2$ was 0.99, against stated acceptance criteria of $R^2 >$ 0.97 and peak-force error < 10%. | 10.1002/pat.70732 | Verified against full text - Included |
| Hou (2024) | 3-D Trajectory Planning Scheme for Shoe Upper Processing | The study is an experimental engineering-method evaluation. | The authors acknowledge camera-resolution limits (up to 0.6 mm at the farthest imaging distance), registration-related spatial error, and material-dependent differences between visually extracted and manually taught trajectories. | The conclusions are reasonably supported for the tested setup: the authors report repeated measurements and testing on three shoe styles, with low registration errors and Z-axis trajectory errors below 1 mm in the reported experiments. | Registration accuracy: the proposed method had RMSEs of 0.242, 0.240, 0.198, and 0.187 mm across four point-cloud pairs, lower than SVD, RANSAC, and MAC in each comparison; the paper also characterizes its accuracy as below 0.3 mm relative to the three alternatives and reports use of fewer correspondences. | 10.1109/TIM.2024.3476594 | Verified against full text - Included |